(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
26 November 2009 (26.11.2009)

PCT

(10) International Publication Number
WO 2009/142591 A1

(51) International Patent Classification:
G06K 19/077 (2006.01)

(21) International Application Number:
PCT/SE2009/050571

(22) International Filing Date:
20 May 2009 (20.05.2009)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:

0801160-3	20 May 2008 (20.05.2008)	SE
0801164-5	20 May 2008 (20.05.2008)	SE
0801165-2	20 May 2008 (20.05.2008)	SE

(71) Applicant *(for all designated States except US)*: **SWECARD INTERNATIONAL SA** [CH/CH]; 16 Rue de Contamines, CH-1206 Geneve (CH).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **ASPLUND, Johan** [SE/SE]; Timmermansgatan 43, S-118 55 Stockholm (SE). **BREVEMARK, Daniel** [SE/SE]; Primusgatan 98, S-112 47 Stockholm (SE). **FRANKLIN, Gustav** [SE/SE]; Vretstigen 2, S-791 43 Falun (SE). **ADÅS, Christian** [SE/SE]; Sunnanö 141, S-781 94 Falun (SE).

(74) Agents: **BRANN AB** et al.; P.O. Box 17192, S-104 62 Stockholm (SE).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

(54) **Title**: SMART CARD MANUFACTURE

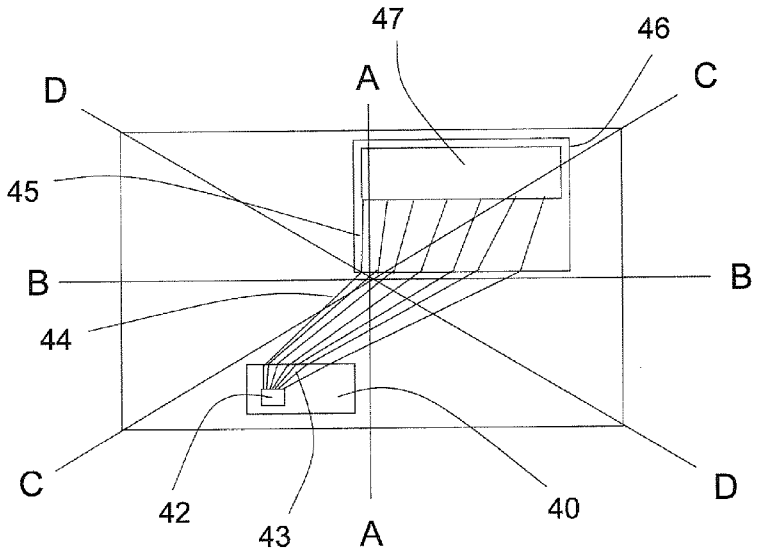

Fig. 4

(57) **Abstract**: The invention relates to a device comprising an essentially rectangular substrate having at least one bending sensitive component integrated in the substrate. The substrate has bending lines. There is a bending free region which is located such that it is nowhere nearer a bending line than 5 mm. The bending sensitive component(s) are placed essentially entirely within said bending free region.

WO 2009/142591 A1

SMART CARD MANUFACTURE

The invention relates to manufacture of so active called smart cards comprising integrated components which are sensitive to bending of the card.

Background of the Invention

Smart cards are plastic cards such as credit cards and the like having electronic components integrated within the body of the card. There are many electrical points of contact in such a card, and these contacts must be able to withstand the bending of the flexible card which inevitably occurs in use (e.g. in an owners wallet) and/or transport of the cards (e.g. via ordinary mail where sorting equipment will subject the cards to various kinds of strains).

There is a standard ISO 7816 that contains a number of dynamic tests (ISO 10373) that a card must pass in order to be acceptable.

Summary of the Invention

Thus, there is a need to provide methods of making smart cards such that the handling of the cards in use and/or transport not likely will cause damage to them. It is important that the components, i.e. electronic circuits and active components in addition to the ordinary "smart chip", are positioned on the card in such a way that they are not affected by bending, in order to provide flexibility and to insure a long life of the card.

In accordance with the invention there are defined bending free regions where the bending radius will be allowed to occur. Rigid components, or more generally speaking components that contribute to increase the relative rigidity of the card itself must be placed in these bending free regions. Thus, the regions adjacent each bending line will to the extent possible be free of components.

The present invention offers a solution to this problem, by a device, in particular a smart card, having a structure such that the sensitivity to bending is minimized. Such a card is defined in claim 1.

In another aspect of the invention there is provided a method of making such a device, the method being defined in claim 11.

The invention will be described below in detail with reference to the drawings.

Brief Description of the drawings

Figure 1 illustrates definition of bending lines;
Figure 2A shows bending in one direction;
Figure 2B shows bending in a direction perpendicular to the direction shown in Fig. 2A,
Figure 3 illustrates definition of bending free regions;
Figure 4 shows an embodiment of the design according to the invention.

Detailed Description of the Invention

For the purpose of the present application we define bending lines on a smart card as follows.

Fig. 1 illustrates schematically a smart card, generally designated with reference numeral 10. A standard card of this type is rectangular having two parallel long sides and two parallel short sides. Between the center points of each pair of sides a straight line referred to as a "perpendicular bending line" is defined. In the figure there are also shown the main bending lines. In Fig. 1 this is illustrated such that the bending line A-A extending between the long sides is denoted A-A, and the bedning line extending between the short sides is denoted B-B.

In addition to these bending lines we define also "diagonal bending lines" extending between the corners of the card. As illustrated in Fig. 1 the bending line extending between the lower left corner and the upper right corner is designated C-C, and the bending line extending between the upper left corner and the lower right corner is designated D-D. Bending along these diagonal bending lines will never be as severe as along the perpendicular lines, but they nevertheless need to be taken into consideration when designing a smart card having a plurality of delicate and bending sensitive components..

Furthermore, we define "bending free regions" as regions on the card surface which are located no nearer to the bending lines than about 5 mm. This is illustrated in Fig. 2, and thus we have four quadrants I, II, III and IV on a card, each quadrant being subdivided in two such bending free regions a, b, c, d , e, f, g, h. Of course these regions are not entirely free from being affected by bending, but for all practical purposes and in particular if bending never exceeds the criteria of the standard ISO 7816 (test ISO 10373), they can be regarded as "bending free". Thus, by bending free is meant that bending within the limits of said standard will not affect the components for a period of at least three years..

An important assumption for the purpose of the invention is to consider the card as "freely clamped". This means that bending will occur essentially along the bending lines and that the edges of the card will be essentially straight and the bending will occur between the edges with some bending radius between the edges.

This is illustrated in Figs. 2a-b. In Fig. 2a bending occurs along the line A-A of Fig. 1, whereas the line B-B is straight, and in Fig. 2b bending occurs along line B-B of Fig. 1 whereas the line A-A is straight. In Fig. 2a the edges of the long side of the card are straight and in Fig. 2b the short sides of the card are straight.

On a smart card the smart chip module (referred to as an ISO module in the following) is located essentially on the bending line B-B and is thus exposed to shearing forces when the card is bent. However, the ISO module is in itself very robust and can accommodate the bending forces without being damaged.

The inventive idea behind the present invention is the insight that in order to be able to make a smart card having at least one component sensitive to the bending forces that a card may encounter during its life, and that will not be subject to damage of said sensitive component during use of the card, one has to place the components according to a design strategy. Namely, the components should be placed in the above defined bending free regions.

In particular for a smart card having a display, and active components for processing information such as a memory, a processor and the like, it is crucial that they be protected from both the bending forces mentioned above, but also it must be insured that e.g. temperature changes will not affect the components. If the thermal coefficient of expansion of the substrate on which the components are placed is too large, the connections to the components may be affected, possibly even break, and the components may come off the substrate due to the strain.

In order to avoid such problems the sensitive components are mounted on a substrate that is very durable and exhibits very low thermal coefficient of expansion. One example of such a material is KAPTON®. Kapton is a polyimide film developed by DuPont which can remain stable in a wide range of temperatures, from -273 °C to +400 °C. Kapton is used in, among other things, flexible printed circuits (flexible electronics). This is a relatively stiff material, at least stiffer than the material which is used for the smart card itself.

This substrate will function as a small circuit board carrying the components. There will be routing structures for electrical signals to and from the components provided on the substrate. For example, there will be electrical leads which are to be connected to e.g. a display module. The circuit board and the display will be located in different regions of the smart card, and hence the leads will inevitably cross the above discussed bending lines and the regions close to the bending lines, i.e. outside the bending free regions.

If the KAPTON (or other suitable material) substrate were made such that it extends across a bending line in order to match the contacts on said exemplary display module, the stiffness of the card would increase in this area. This would bring about increased stress. Furthermore, KAPTON is a very expensive material, and large pieces of such material would unduly add to the total cost of the substrate.

Thus, in accordance with the invention, the size of the substrate carrying the active components is made small enough that it will fit in one bending free

region. In a preferred embodiment this substrate is placed in the octant labelled f in Fig. 3. However, of course in principle it could be placed in any of the bending free regions a-g. Note that the dimensions of the regions in Fig. 3 are not to scale.

Also, the contact pitch of the active components on the substrate is very small, and the contacts cannot be directly attached or contacted to the other components, e.g. the display module. Therefore, what is referred to as a fanning out of the electrical leads (routings) is made, illustrated schematically in Fig. 4.

Here, a KAPTON substrate 40 carrying an active component 42 has routed electrical leads 43 provided on its surface. The very small pitch at the component 42 is "fanned out" on the substrate to a wider pitch at the edge of the substrate. The substrate is contacted with electrical leads 44 on the smart card substrate which are further fanned out and contacted with leads 45 on a flexible display module 46 having a display window 47.

The display module extends slightly across the bending line A-A, but it is flexible, as mentioned, and thus it can withstand the bending forces.

The active component substrate 40 is suitably attached to the smart card by an adhesive tape.

A method of making a device according to the invention comprises providing a substrate having bending characteristics meeting the requirements of ISO 7816 (ISO 10373). Said bending sensitive component is attached to said substrate in selected regions on said substrate. Selecting said regions comprises identifying regions on said substrate which at all points within such region are more than 5 mm remote from bending lines on said substrate. The bending lines being defined as i) perpendicular bending lines extending between center points of opposing sides of said substrate, and ii) diagonal bending lines extending between opposite corners of said substrate. Preferably the method provides a device which is a smart card.

CLAIMS:

1. A device comprising an essentially rectangular substrate having at least one bending sensitive component integrated in the substrate;

characterized by

the substrate having bending lines;

a bending free region which is located such that it is nowhere nearer a bending line than a minimum distance, and by

said bending sensitive component(s) being placed essentially entirely within said bending free region.

2. A smart card comprising an ISO module and at least one bending sensitive component integrated in the card, the card comprising an essentially rectangular substrate;

characterized by

the card having bending lines;

a bending free region which is located such that it is nowhere nearer a bending line than 5 mm, and by

said bending sensitive component(s) being placed essentially entirely within said bending free region.

3. The device as claimed in claim 1 or the smart card as claimed in claim 2, wherein said bending lines are straight lines that extend across the card between mid points (A-A, B-B) of the sides of the card and between the corners of the card (C-C, D-D), respectively.

4. The device or smart card as claimed in claim 3, wherein the bending lines (A-A, B-B, C-C, D-D) all cross each other in the center point of the smart card, thereby defining eight octants on the card.

5. The device or smart card as claimed in claim 3 or 4, wherein there are eight bending free regions located one in each of said octants, each region being located such that it is nowhere nearer a bending line than 5 mm.

6. The device or smart card as claimed in claim 3, 4 or 5, wherein said bending sensitive component(s) is/are placed entirely within said bending free region.

7. The device or smart card as claimed in claim 3, 4, 5 or 6,

8. The device or smart card as claimed in claim 3, wherein said bending sensitive component(s) is/are provided on a separate substrate which is located within one of said octants.

9. The device or smart card as claimed in claim 8, wherein electrical leads from said components are fanned out on said separate substrate from a small pitch to a wider pitch.

10. The device or smart card as claimed in claim 9, wherein the fanned out leads are contacted to leads on the essentially rectangular substrate, which in turn are further fanned out to a still wider pitch and contacted to further components.

11. The device or smart card as claimed in any preceding claim, wherein said bending free region is located such that it is nowhere nearer a bending line than a minimum distance of 5 mm.

12. A method of making a device comprising an essentially rectangular substrate and having at least one bending sensitive component integrated in the substrate, comprising:

providing a substrate having bending characteristics meeting the requirements of ISO 7816 (ISO 10373);

attaching said bending sensitive component to said substrate in selected regions on said substrate;

wherein

selecting said regions comprises identifying regions on said substrate which at all points within such region are more than 5 mm remote from bending lines on said substrate;

said bending lines being defined as

i) perpendicular bending lines extending between center points of opposing sides of said substrate, and

ii) diagonal bending lines extending between opposite corners of said substrate.

13. The method as claimed in claim 11, wherein the device is a smart card.

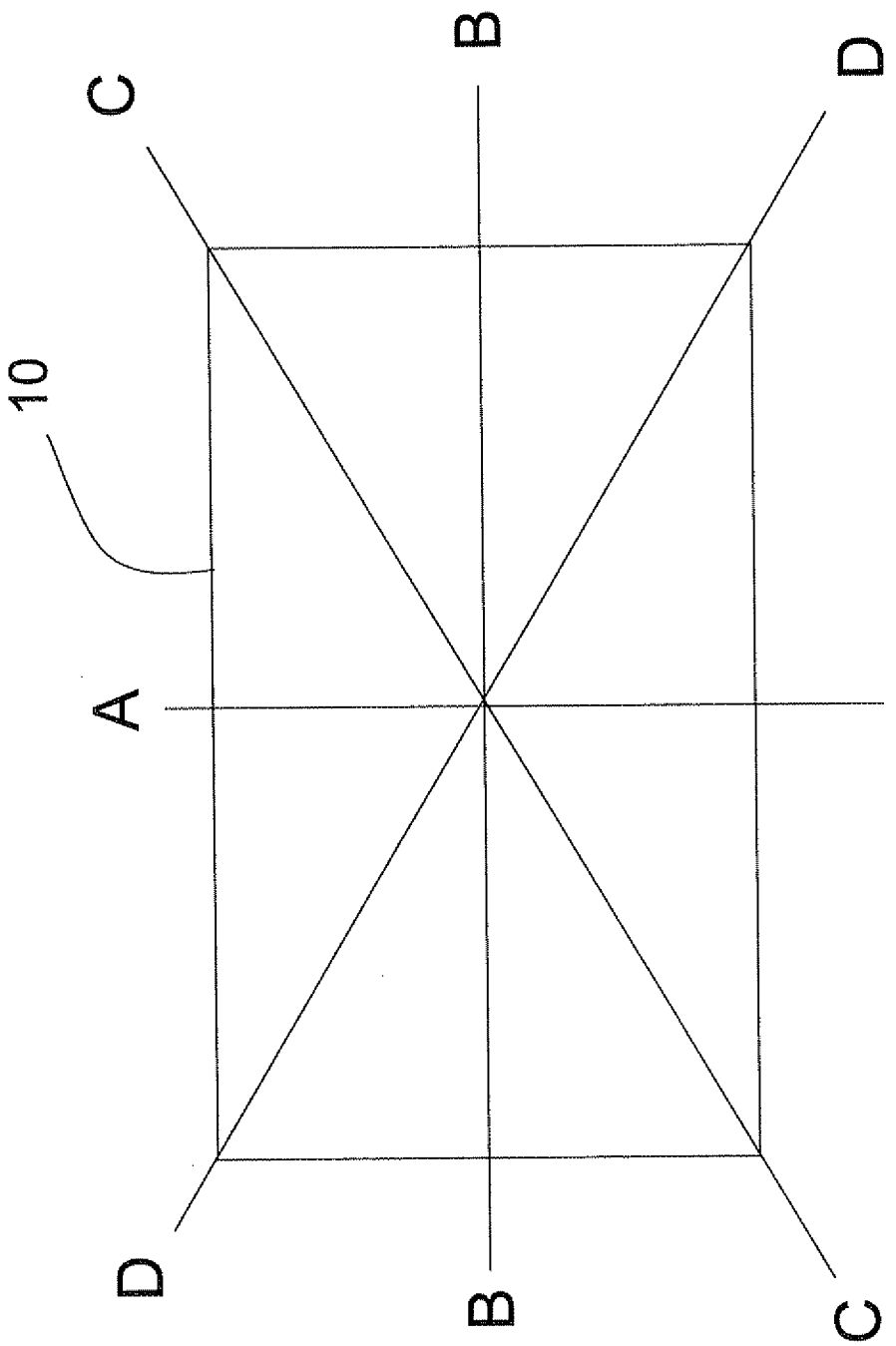

Fig. 1

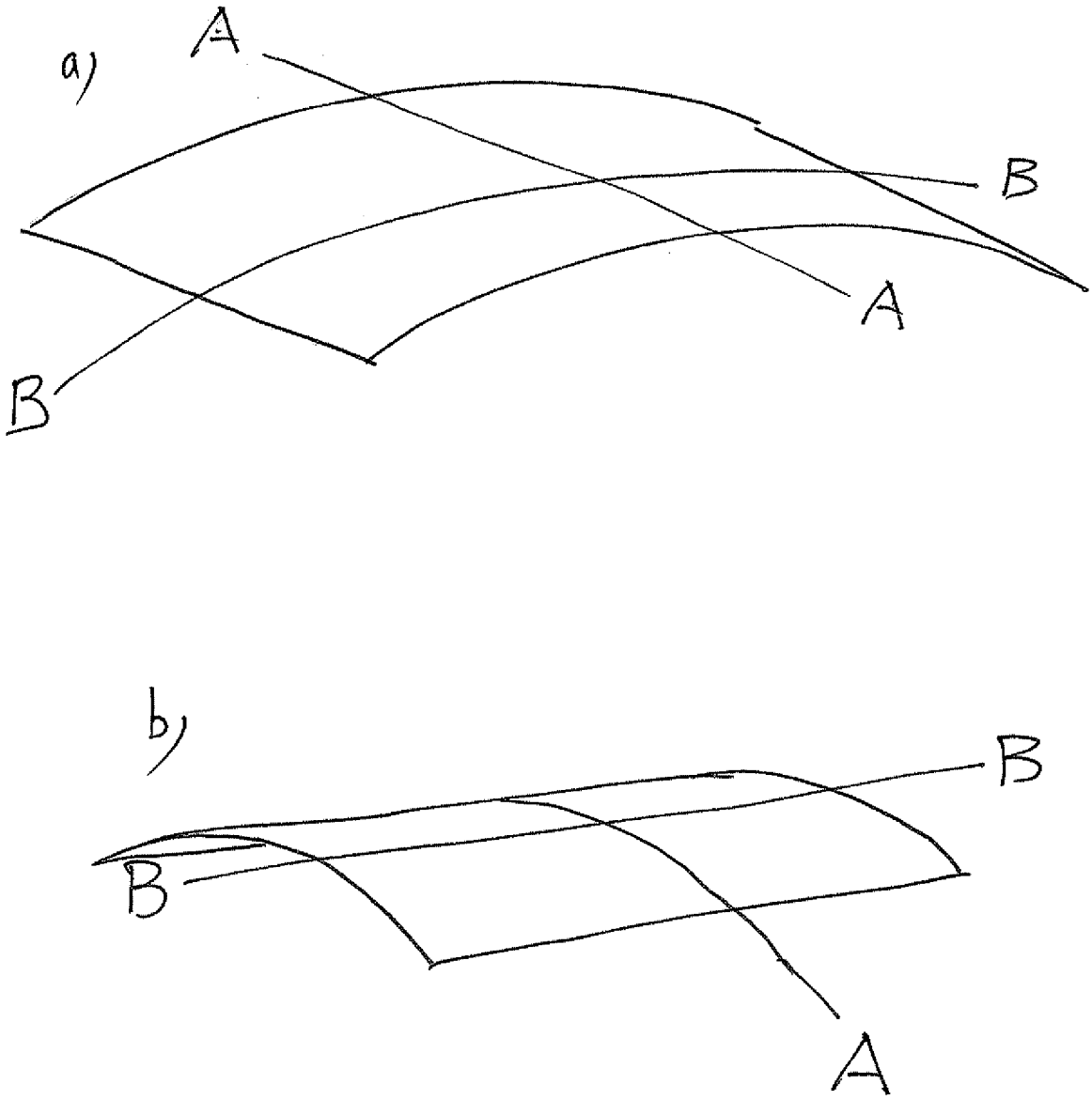

Fig. 2

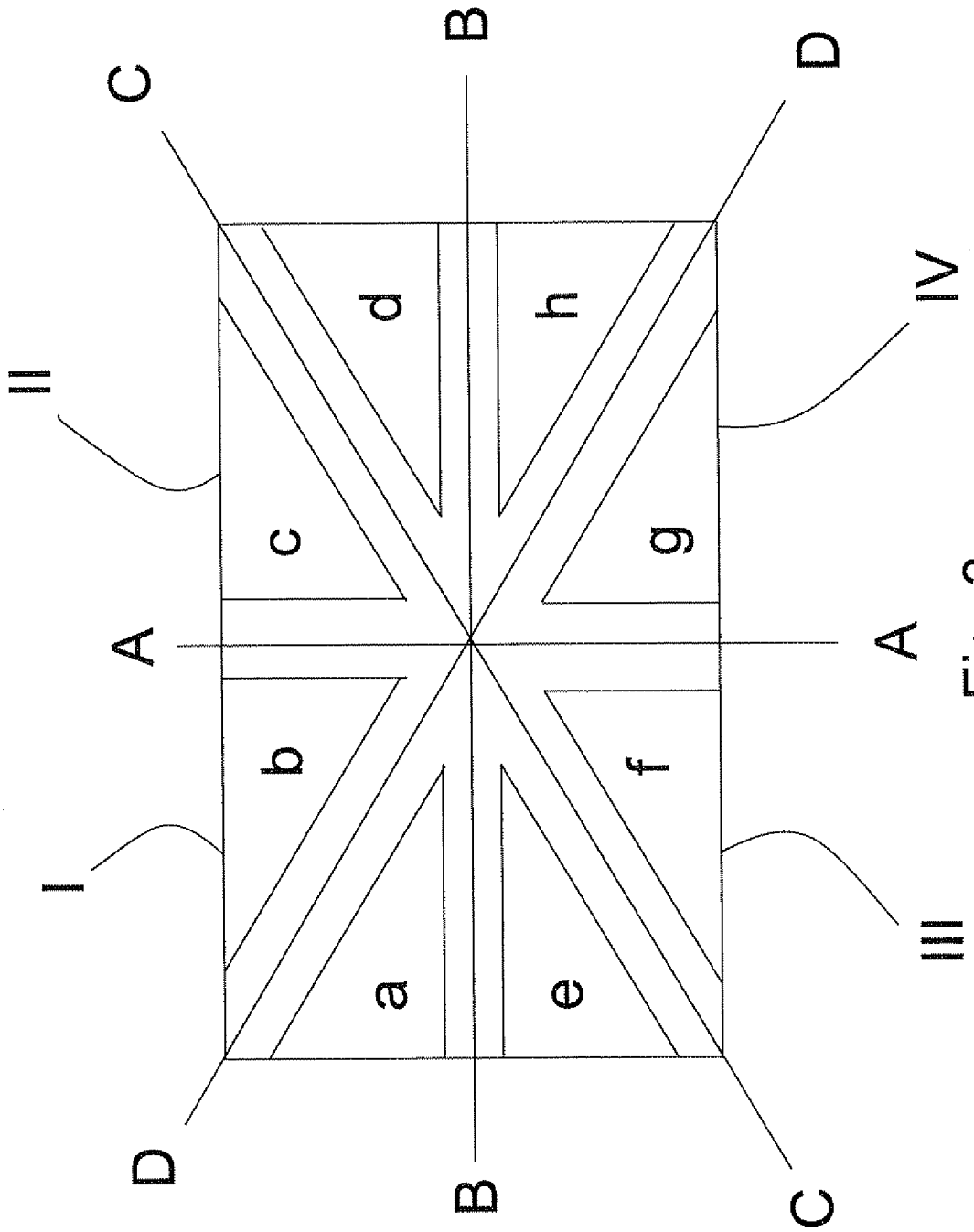

Fig. 3

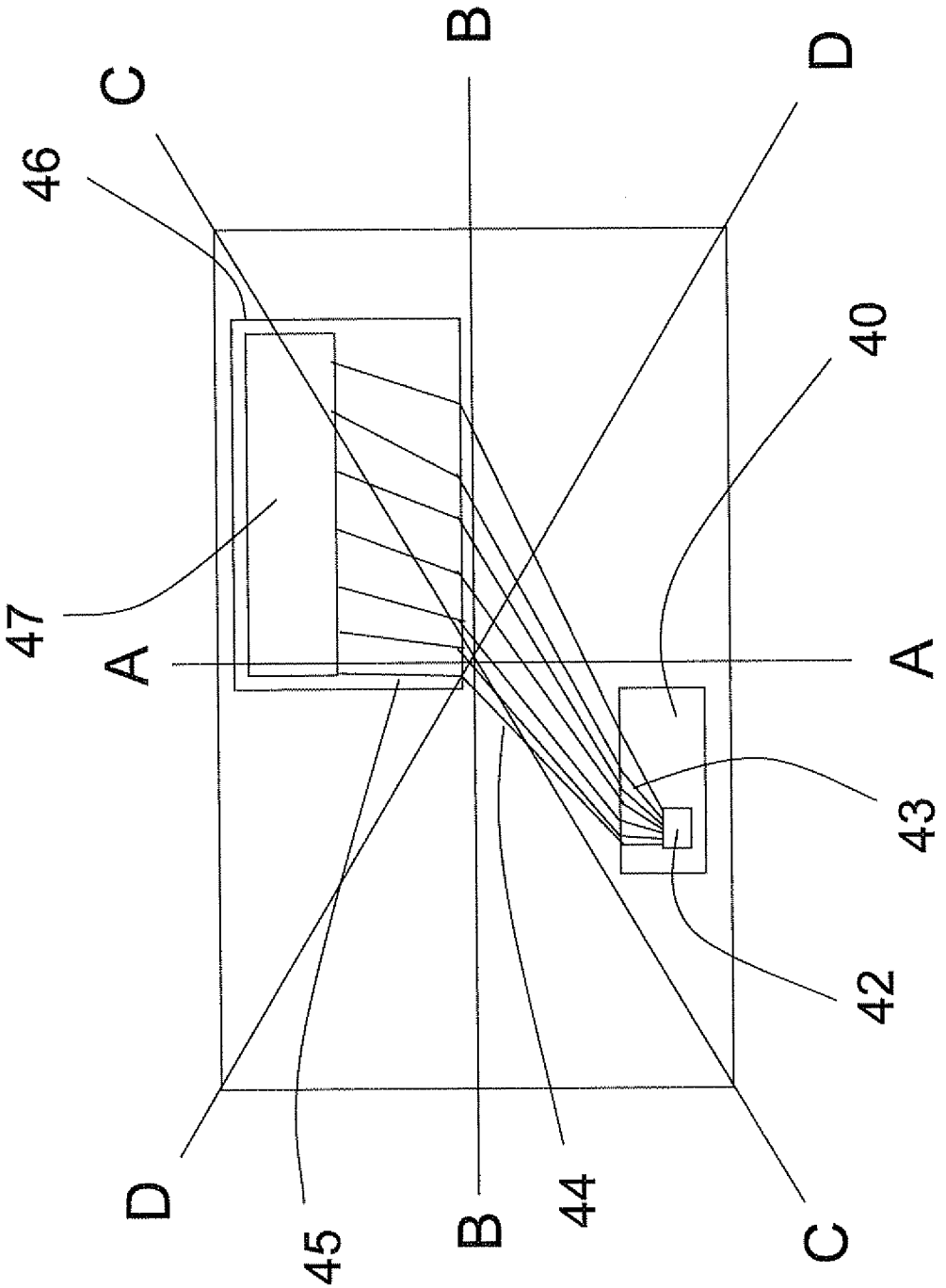

Fig. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2009/050571

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: G06K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2006107968 A1 (INNOVATER, INC.), 12 October 2006 (12.10.2006), paragraph [0013]	1-2,11
A		3-10,12-13
	--	
X	US 4639585 A (HAGHIRI-TEHRANI, YAHYA ET AL), 27 January 1987 (27.01.1987), figures 3a-3c, 5	1-2,11
A		3-10,12-13
	--	
X	FR 2595848 A1 (MITSUBISHI DENKI KABUSHIKI KAISHA), 18 Sept 1987 (18.09.1987), figure 1	1-2,11
A		3-10,12-13
	--	

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
1 Sept 2009	02-09-2009
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Tomas Erlandsson / EÖ Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2009/050571

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6376769 B1 (CHUNG, KEVIN KWONG-TAI), 23 April 2002 (23.04.2002), column 1, line 12 - line 53; column 29, line 16 - column 30, line 9	9-10

--

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2009/050571

International patent classification (IPC)
G06K 19/077 (2006.01)

Download your patent documents at www.prv.se
The cited patent documents can be downloaded:

- From "Cited documents" found under our online services at www.prv.se (English version)
- From "Anförda dokument" found under "e-tjänster" at www.prv.se (Swedish version)

Use the application number as username. The password is **LJRRQMKYWJ**.

Paper copies can be ordered at a cost of 50 SEK per copy from PRV InterPat (telephone number 08-782 28 85).

Cited literature, if any, will be enclosed in paper form.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/SE2009/050571

WO	2006107968	A1	12/10/2006	AU	2006231517	A	12/10/2006
				CA	2604153	A	12/10/2006
				CN	101189626	A	28/05/2008
				EP	1866846	A	19/12/2007
				JP	2008538430	T	23/10/2008
				KR	20080005364	A	11/01/2008
				US	7237724	B	03/07/2007
				US	20060226240	A	12/10/2006
				ZA	200708492	A	29/10/2008
US	4639585	A	27/01/1987	AT	78115	T	15/07/1992
				DE	3420051	A	05/12/1985
				DE	3586297	D	13/08/1992
				EP	0163880	A,B	08/07/1992
				SE	0163880	T3	
				ES	8607586	A	01/11/1986
				HK	54095	A	21/04/1995
				JP	1841211	C	25/04/1994
				JP	5048514	B	21/07/1993
				JP	60256887	A	18/12/1985
FR	2595848	A1	18/09/1987	JP	62214998	A	21/09/1987
				US	4764803	A	16/08/1988
				US	5031026	A	09/07/1991
US	6376769	B1	23/04/2002	CN	1352804	A	05/06/2002
				EP	1194955	A	10/04/2002
				JP	2003500832	T	07/01/2003
				WO	0070676	A	04/07/2002